Topic: Hyperbolic derivatives

Question: Find the derivative of the hyperbolic trig function.

$$y = \cosh\left(x^2 - 1\right)$$

Answer choices:

A $y' = -2x \sinh\left(x^2 - 1\right)$

B $y' = -2x \cosh\left(x^2 - 1\right)$

C $y' = 2x \sinh\left(x^2 - 1\right)$

D $y' = 2x \cosh\left(x^2 - 1\right)$

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Solution: C

Make a substitution, letting $u = x^2 - 1$ and $u' = 2x$. Then $y = \cosh u$, so

$$y' = \left[\sinh\left(x^2 - 1\right)\right](2x)$$

$$y' = 2x \sinh\left(x^2 - 1\right)$$

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Topic: Hyperbolic derivatives

Question: Find the derivative of the hyperbolic trig function.

$$y = x^2 \sinh x$$

Answer choices:

A $y' = x \cosh x + 2 \sinh x$

B $y' = x^2 \cosh x + 2x \sinh x$

C $y' = x \cosh x - 2 \sinh x$

D $y' = x^2 \cosh x - 2x \sinh x$

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Solution: B

To find the derivative of

$$y = x^2 \sinh x$$

use the product rule with the chain rule.

$$y' = x^2 \frac{d}{dx}\left(\sinh x\right) + \left(\sinh x\right) \frac{d}{dx}\left(x^2\right)$$

$$y' = x^2 \cosh x + 2x \sinh x$$

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Topic: Hyperbolic derivatives

Question: Differentiate the function.

$$f(x) = \sinh(\cosh(2x))$$

Answer choices:

A $f'(x) = 2\sinh(2x)\sinh(\sinh(2x))$

B $f'(x) = 2\sinh(2x)\cosh(\sinh(2x))$

C $f'(x) = 2\sinh(2x)\cosh(\cosh(2x))$

D $f'(x) = 2\cosh(2x)\cosh(\cosh(2x))$

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Solution: C

Given the function

$$f(x) = \sinh(\cosh(2x))$$

apply chain rule and take the derivative of $\sinh$ first, leaving the inner functions untouched, but multiplying by the derivative of the inside function.

$$f'(x) = \cosh\big(\cosh(2x)\big)\left(\frac{d}{dx}\cosh(2x)\right)$$

Take the derivative of $\cosh$, leaving the inner function untouched, but multiplying by the derivative of the inside function.

$$f'(x) = \cosh\big(\cosh(2x)\big)\big(\sinh(2x)\big)\frac{d}{dx}(2x)$$

Then take the derivative of $2x$.

$$f'(x) = \cosh\big(\cosh(2x)\big)\big(\sinh(2x)\big)(2)$$

$$f'(x) = 2\sinh(2x)\cosh\big(\cosh(2x)\big)$$

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